Regional Operational Plan No. SF.2A.2021.04

Operational Plan: Inriver Netting Pilot Study at the RM 19 Kenai River Sonar Site, 2021

by

Robert Begich

December 2021

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	E
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	′
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	″
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

REGIONAL OPERATIONAL PLAN NO. SF.2A.2021.04

OPERATIONAL PLAN: INRIVER NETTING PILOT STUDY AT THE KENAI RIVER RM 19 SONAR SITE, 2021

by
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December 2021

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This document should be cited as follows:
Begich, R. N. 2021. Operational plan: Inriver netting pilot study at the Kenai River RM 19 sonar site, 2021. Alaska Department of Fish and Game, Division of Sport Fish, Regional Operational Plan No. ROP.SF.2A.2021.04, Anchorage.

SIGNATURE PAGE

Project Title:	Inriver Netting Pilot Study at the Kenai River RM 19 Sonar Site, 2021
Project Leader(s):	
Division, Region and Area:	Division of Sport Fish, Region II, Soldotna; Division of Commercial Fisheries, Central Region, Soldotna
Project Nomenclature:	S-2-NEW
Period Covered:	August 2021–December 2021
Field Dates:	August, 2021
Plan Type:	Category II

Approval

Title	Name	Signature	Date
Area Research Supervisor	Robert Begich		
Project Biologist	Tony Eskelin		
Biometrician	Jiaqi Huang		
Regional Research Supervisor	Tim McKinley		
Regional Research Supervisor	Jack Erickson		
Regional Research Supervisor	Richard Brenner		

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ABSTRACT

This exploratory project will evaluate the efficacy of using drift gillnets as an additional tool to apportion sonar estimates of migrating salmonids to individual species, especially sockeye salmon (*Oncorhynchus nerka*), at river mile 19 on the Kenai River in Upper Cook Inlet. Sonar estimates at RM 19 are currently apportioned via fish wheel, and gillnets may provide additional information about the proportions of sockeye salmon that are near or outside of the areas sampled by fish wheels. Although species apportionment by fish wheel has begun on July 1 since 2020, this pilot study focuses on species apportionment beginning in early August until the RM 19 sonar project closes for the season because this is when large numbers of pink salmon (*O. gorbuscha*) may be passing the RM 19 sonar site at the same time that late-run sockeye salmon are passing. Results from this 2021 pilot study will be used to guide the development of an experimental design during future years.

Keywords: Kenai River, DIDSON, sockeye salmon, *Oncorhynchus nerka*, pink salmon, *Oncorhynchus gorbuscha*, apportionment, gillnet, Kenai RM 19 sonar, Upper Cook Inlet

INTRODUCTION

PURPOSE

The Alaska Department of Fish and Game (ADF&G), Division of Commercial Fisheries, uses a DIDSON (dual-frequency identification sonar) annually to estimate the number of sockeye salmon (*Oncorhynchus nerka*) passing river mile (RM) 19 on the Kenai River of Upper Cook Inlet (UCI), Alaska (Figure 1). The total number of salmon passing the sonar site as well as fish wheel catches for species apportionment are currently used to estimate the number of sockeye salmon in the total sonar passage estimate at RM 19 (Glick and Faulkner 2019). The Division of Sport Fish also uses these estimates to manage the inriver sport fishery to achieve the late-run sockeye salmon escapement goal, so an accurate apportionment of sockeye salmon is necessary, especially late in the season. The purpose of this study is to determine whether the addition of drift gillnets may be a feasible method for improving the species apportionment at RM 19 during late-run sockeye salmon passage.

BACKGROUND

The Kenai River drainage in western Kenai Peninsula is approximately 5,200 km^2 and is the major sockeye salmon producing watershed in Cook Inlet (Figure 1). The Kenai River also produces significant runs of coho salmon (*O. kisutch*), pink salmon (*O. gorbuscha*), and Chinook salmon (*O. tshawytscha*). The Division of Commercial Fisheries long-standing comprehensive sockeye salmon stock assessment program drives the implementation of the *Kenai River Late-Run Sockeye Salmon Management Plan 5AAC 21.360* and relies on the RM 19 DIDSON to formulate sockeye salmon abundance estimates for the inriver run and serves as the basis for the spawning escapement estimates. The Kenai River sockeye salmon assessment program initially used sonar systems deployed on both banks of the Kenai River at RM 19 in 1968 to enumerate passage and estimate the annual migration of sockeye salmon into the Kenai River watershed (Namvedt et al. 1977; Davis 1971). Over several decades, the sockeye salmon stock assessment program has undergone numerous improvements to more accurately estimate inriver abundance, including a move from single beam (Bendix Corp.) sonar to the more advanced multibeam DIDSON sonar technology in 2007 (Belcher et al. 2001, 2002; Maxwell et al. 2011).

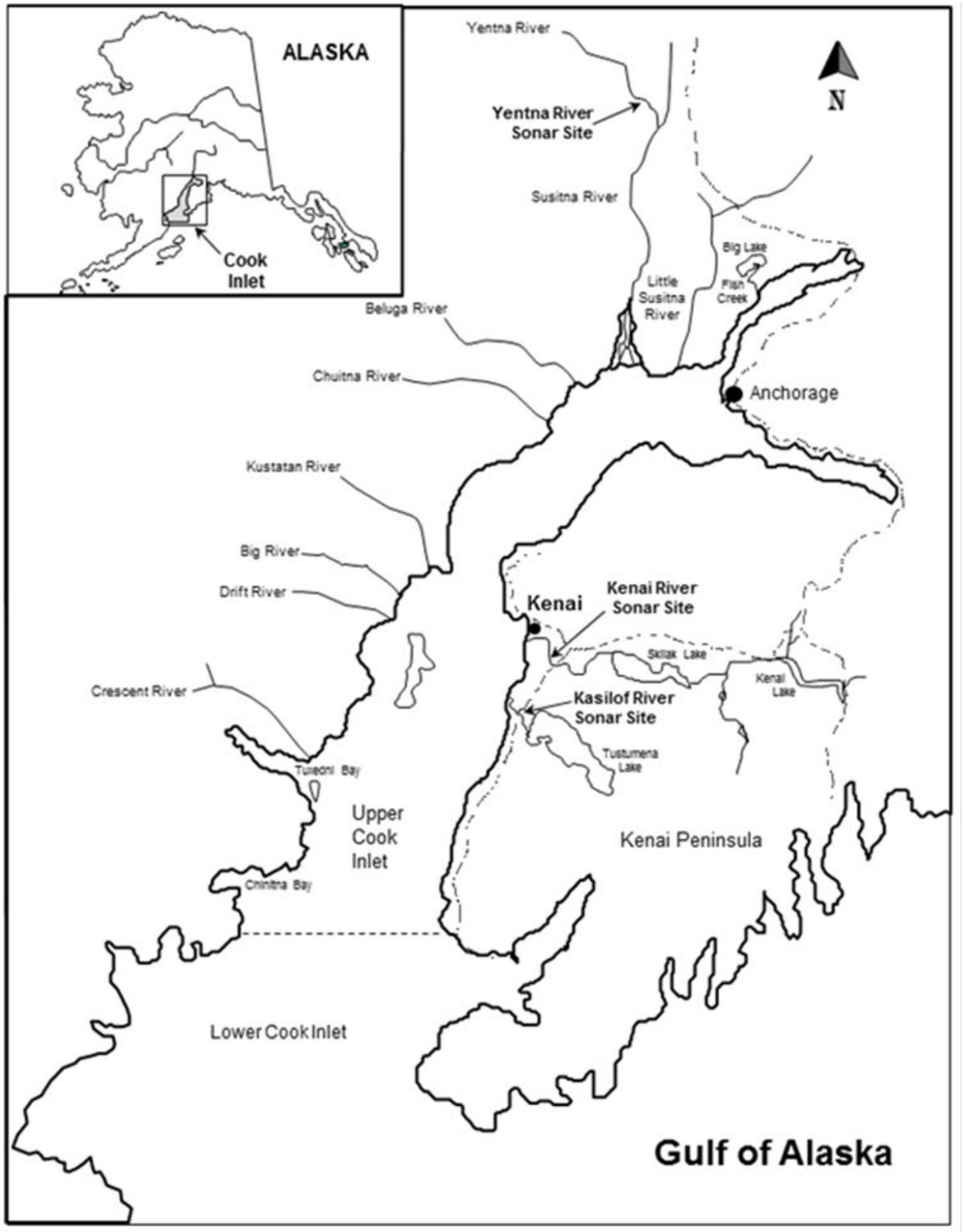

Figure 1.–Map showing locations of Division of Commercial Fisheries sonar sites in Cook Inlet including the Kenai River RM 19 sonar site used to enumerate sockeye salmon passage.

Inriver assessment of sockeye salmon requires an estimate of the proportion of sockeye salmon in the total sonar salmon passage estimate. Initially, during the development of the RM 19 sonar program, gillnets and fish wheels were fished to obtain age, sex, and length (ASL) samples for brood stock information, but only fish wheels were used to apportion (by species) the total sonar salmon passage estimates, especially during even years in August, when the sockeye salmon run was ending and large numbers of pink salmon entered the river (Davis 1971; Namvedt et al. 1977). Fish wheels were operated on both banks of the Kenai River at RM 19 until the mid-1980s. During subsequent years, ADF&G has primarily operated a north-bank fish wheel due to budget cuts, issues pertaining to private land ownership on the south bank, and the prevailing view that species composition was similar between fish wheels on either bank (Ken Tarbox, retired biologist, ADF&G, Soldotna, AK, personal communication). As such, from the mid-1980s through 2020, ASL and species apportionment has been conducted primarily from the north bank fish wheel.

Historically, species apportionment was not considered a significant source of error in Kenai River sockeye salmon passage estimates and sonar counts were generally only apportioned to species by the fish wheels in years when other species of salmon reached 5%. Mark-recapture studies were conducted in 2006–2008, which indicated that apportioned DIDSON passage estimates calculated from north bank fish wheel were relatively unbiased and precise (Willette et al. 2012). However, during recent years, sockeye salmon have been entering the river later than previously recorded. For example, the 2014–2015 and 2017–2018 sockeye salmon run midpoints ranged from 7 to 12 days late compared to the historical midpoint of the run, and the most recent 2020 run midpoint was approximately 15 days late (Glick and Marston *In prep*). The later timing of the sockeye salmon migration into the Kenai River has resulted in a greater overlap of sockeye salmon and pink salmon at the RM 19 sonar site during August.

Even though ADF&G has validated the north bank fish wheel as a valuable apportionment tool (Glick and Willette 2016), there is renewed interest to investigate gillnetting as a potential method to apportion salmon estimates at RM 19 in areas not covered by the fish wheel. Improvements to apportionment may become import if the sockeye salmon runs continue to have later run timing that overlaps with pink salmon runs to a greater extent than was observed historically.

OBJECTIVES

This project is a preliminary exploration of the use of drift gillnets to capture salmon migrating past the RM 19 sonar site. Information from this initial project may be used to develop an expanded species apportionment project in the future but because it will not be conducted throughout the entire period of sonar assessment, the 2021 project is not designed to provide sufficient data to apportion sockeye salmon from the total 2021 salmon passage estimates at the RM 19 sonar site. However, this project may provide necessary methodological information to use in developing future projects that examine the salmon migration composition at RM 19. The 2021 objectives are as follows:

PRIMARY OBJECTIVES

1) Estimate the daily proportion of sockeye salmon captured in gillnets from the nearshore south and north bank fish wheel "zones" at RM 19 such that the proportion estimate is within 15 percentage points of the true value 95% of the time.
2) Estimate the daily proportion of sockeye salmon captured in gillnets from the midshore and offshore ensonified "zones" of the south and north banks at RM 19 such that the

proportion estimate is within 15 percentage points of the true value 95% of the time.

SECONDARY OBJECTIVES

1) Determine the feasibility of using 9.1 m length by 3.1 m depth gillnets of 3 mesh sizes (10.2 cm [4.0 inch], 12.1 cm [4.75 inch], and 12.7 [5.0 inch]) to capture salmon migrating past the RM 19 sonar project site.
2) Determine the feasibility of collecting, holding for sampling, and marking (visible external fin clip or tag) salmon captured during gillnetting operations at RM 19.
3) Determine the feasibility of designing future studies to examine differences in the species composition among various mesh-sized gillnets.

METHODS

STUDY DESIGN

Drift gillnets will be used to capture migrating salmon passing the RM 19 sonar site from August 1 to the completion of the sonar project for the season (approximately August 20). Gillnet captures will be used to estimate proportions of fish by species passing through fishwheel and ensonified "zones," and the gillnet CPUE for various salmon will also be estimated. These drift gillnets, consisting of 12 cm (4.75-inch), 10 cm (4.0-inch), and 12.7 cm (5.0-inch) mesh, will be referred to as simply "gillnet" hereafter.

Netting Schedule and Area

Netting will be conducted each Tuesday and Thursday for the duration of the project. The netting crew will be composed of a minimum of 3 staff (2 fishery technicians and 1 fishery biologist), working a morning shift (6:00 AM–2:00 PM) and evening shift (3:00 PM–11:00 PM) each week. Each technician will be scheduled 2 days per week for 8 hours per day of which approximately 6 hours (7:00 AM–1:00 PM or 4:00 PM–10:00 PM) will be spent netting. The remainder of the time will be for travel to and from the work site, required maintenance, and a 0.5-hour lunch break. The gillnet schedule, based on availability of staff and nets, is listed daily below.

Date	Mesh
5 Aug	4.75
10 Aug	4.75
12 Aug	4.0, 4.75
17 Aug	4.0, 4.75, 5.0
19 Aug	4.0, 4.75, 5.0
24 Aug	4.0, 4.75, 5.0

The gillnet will be fished with equal frequency in 3 different zones on each bank: 1 nearshore "fishwheel zone" and 2 offshore "ensonified zones." Each fishwheel zone is defined as the nearshore area immediately downstream of each fishwheel from the riverbank out to a distance of approximately 10 m toward the thalweg. The 2 ensonified zones on each bank consist of midshore and offshore areas that together with the fishwheel zone collectively span from the bank immediately downstream of the sonar pod to a distance of 30 m toward the thalweg. Each day, the netting crew will work with sonar staff to ensure the nearshore netting areas do not interfere with

the deflection panel near the sonar pods on either bank. Netting will start immediately downstream of the sonar pod and consist of 3 contiguous 10 m long sets (nearshore at 0–10 m, midshore at 10–20 m, and offshore at 20–30 m). Rangefinders, and if necessary, anchored buoys set in the river channel, will be used to ensure the net is approximately within the specified cross-sectional area, and depth sounders may be used to ensure river depths do not exceed gillnet depth. Effort will be made to ensure each set is within the predetermined area. In practice, the fish wheel and ensonified zones on each river bank may have different substrate profiles, depth, and discharge characteristics such that some zones may require little effort to maintain proper drift whereas other zones could require increased effort because of problematic areas (snags, large rocks, fishing docks, boat traffic). The goal will be for crews to net each area equally to the extent practical. Nets will be deployed perpendicular to each bank and a drift will be terminated if any of the following occur: 1) a large Chinook salmon is known to be captured in the net, 2) the net becomes snagged on the bottom or is not fishing properly, 3) the net is not fishing in the appropriate area, 4) the drift area or zone has been completely fished by the gillnet, or 5) the net is saturated with salmon (usually greater than 10 fish visually noticeable by submerging cork lines and surfacing fish).

DATA COLLECTION

Because multiple sets will occur on each side of the river, the crew will collect data in sampling replicates. Each sampling replicate will consist of 6 sets: 3 sets from each bank starting at the sonar pod (fishwheel zone) and extending outward for a distance of 30 m into the two ensonified zones. That is, netting at the north bank will start nearshore and move off shore for the next 2 sets, which will be followed by netting at the south bank, which starts nearshore and moves offshore for the next two sets. Replicates will be taken in turn. That is, the three sets at the north bank will be followed by the three sets at the south bank before returning to the north bank to begin the next replicate. Based on sonar and fish wheel data, the highest catch rates are anticipated in the nearshore zones and decrease as distance from shore increases. For days when gillnets of more than 1 mesh size are fished, a 6-set replicate will be completed before changing the mesh size.

Primary responsibilities of the netting crew will be to drift nets in the specified areas and to record drift location (south or north bank), drift start and stop times, and number of fish caught by species. The start time will be recorded as the time the crew begins setting the net and the stop time will be recorded as the time the crew begins pulling the net. All data will be recorded electronically using data entry software on a Juniper Systems Inc. Allegro II field computer. After sampling, the crew will download the data onto a desktop computer. If the field computer is not functioning properly, data will be recorded on a data form (Appendix A1). In addition, crews will also fill out a field notebook daily to document observations not covered by the electronic data entry system such as issues with boat traffic, interactions with the public at the netting site, and extent of downstream distance travelled after pulling the net. Additionally, information from holding, marking, and tagging fish from the netting sets will aid project biologists in determining its feasibility for future projects. To attain the desired precision for estimating proportions of sockeye stated in the objectives, at least 43 fish need to be sampled from each zone or 129 fish from each bank for a total of 258 fish each day, if the 43-fish sample size is equally distributed among all 6 zones (Thompson 1987).

DATA REDUCTION

The gillnet crew will return to the Soldotna office following each sampling shift and be responsible for entering data into the field computer and downloading data to the project biologist's desktop computer, which will output the datasets into a comma separated text (.txt) format for analysis.

The project biologist will review the netting data to ensure values of fish enumerated by species and set and pull times are entered into the proper field and within regular bounds. The project biologist will edit the data for obvious coding errors and forward to staff conducting postseason data analyses. All data will be kept in a network-protected computer file, which will be edited and error-checked by appropriate staff for summaries and analysis.

DATA ANALYSIS

The daily proportion estimate($\hat{p}_{sbz}$) of sockeye salmon from zone z (fish wheel [nearshore], midshore, or offshore) of bank b (north bank or south bank) will be calculated using the equation below:

$$\hat{p}_{sbz} = \frac{n_{sbz}}{n_{bz}} \tag{1}$$

where n_{bz} is the total number of fish sampled from zone z of bank b, and n_{sbz} is the number of sockeye salmon sampled from the same zone.

The variance of $\hat{p}_{sbz}$ will be calculated as follows (Cochran 1977):

$$V(\hat{p}_{sbz}) = \frac{\hat{p}_{sbz}(1 - \hat{p}_{sbz})}{(n_{bz} - 1)} \tag{2}$$

SCHEDULE AND DELIVERABLES

Dates	Activity	Personnel
25–31 June	Prepare operational plan	SF, CF
27–31 July	Prepare equipment for the field work, program Allegro computers	SF
2–20 August	Field season collect data	All staff
1–30 September	Prepare data for analysis and forward to RTS	SF
1–31 October	Conduct data analysis	RTS
January 2022	Summarize findings in an FDS report	SF, CF

Note: SF = Division of Sport Fish staff; CF = Division of Commercial Fisheries staff; RTS = Division of Sport Fish, Research and Technical Services staff.

The results from this 1-year operational plan may contribute to the design of future species apportionment studies at the RM 19 sonar site.

RESPONSIBILITIES

Project Leader
Robert Begich, Fishery Biologist III
Duties: Responsible for completing operational plan, ensuring project work is completed, preparing data for analysis, and making future recommendations to regional biologists for future project work.

Consulting Biometrician
Jiaqi Huang, Biometrician IV
Duties: Provide guidance on sampling design, sample size criteria, and data analysis; assist with preparation of operational plan.

Project Biologist Supervisors
Robert Begich, Fishery Biologist III and Tony Eskelin, Fishery Biologist II
Duties: Oversee the project and responsible for hiring, crew supervision, field season preparation, collection of data, data analysis, report writing, and operational planning.

Netting Crew
Fish and Wildlife Technician III (28 July–20 August)
Duties: Capturing and sampling salmon in nets, and recording data on handheld computers while adhering to strict sampling schedules and protocols. Further duties are preventative maintenance and repair of assigned equipment.

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APPENDIX A: SAMPLING FORM

Appendix A1.–Kenai River RM 19 inriver netting sampling form.

KENAI RIVER RM19 NETTING FORM

Page_____of _____

Date:_____ Names:_____

Rep	Set	Bank	Loc	Mesh	Start Time	Stop Time	Species captured						Comments
							Sockeye	Pink	Coho	Chinook	RB	DV	

	Time	Secchi
Start		
End		

Rep: 8 sets, 1 set at each location off each bank **Set:** begin 1 each day **Bank:** Bouy thrown towards (N or S) **Loc:** Location, FAV= below fishwheel, NS=nearshore adjactent to sonar 0-10m offshore, M=mid 10-20m offshore and OFF=offshore 20-30m, **Mesh:** in inches (4.75, etc.) **Start time:** military to nearest sec. when bouy is thrown **Stop time:** military to nearest sec. when leads begin being pulled. **Comments:** any pertinent info. **Secch:** nearest 0.05 m